FirstTemp Genius®

Tympanic Thermometer 3000A

service manual

SHERWOOD® DAVIS & GECK

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1. Introduction

Scope of Manual

This manual is intended for use by qualified service personnel who are familiar with electromechanical devices, and in particular, solid state, digital and analog circuits. Its scope is limited to the use and maintenance of the *GENIUS* Model 3000A Tympanic Thermometer.

There are 6 sections in this manual:

1. **Introduction:** Describes the manual and tells how to use it, describes the methods used to update this manual and presents Sherwood-Davis & Geck's Service Policy.
2. **Principles of Operation:** Describes the principles of operation.
3. **Product Description:** Identifies product reorder numbers, product descriptions and specifications.
4. **Installation and Operation:** Presents installation and operating procedures.
5. **Maintenance:** Provides procedures for preventive and corrective maintenance, including calibration, cleaning and sterilization techniques.
6. **Specifications:** Presents specifications for the *GENIUS* Model 3000A Tympanic Thermometer.

2. Principles of Operation

Introduction/ Theory of Operation

GENIUS is an infrared sensing device specially adapted for use as a clinical thermometer. It senses the infrared emissions from the tympanic membrane and ear canal and calculates body temperature as a function of infrared intensity. By adding a selectable linear offset to the calculation, *GENIUS* is able to display an equivalent temperature reading of an "Oral," "Rectal" or core body temperature measurement.

• How *GENIUS* Derives Temperature of an Infrared Target

1. *GENIUS* uses an infrared sensing device called a thermopile to measure infrared radiation emissions from the ear's tympanic membrane and canal.
2. The thermopile is best described as a series of thermocouples, arranged under ("sensing junctions") and around ("cold junctions") a blackened, "heat-collecting," surface. The thermopile operates by outputting a voltage level, which is a function of the difference in temperature between the thermocouple "cold junctions" and the hot, or "sensing junctions."
3. When the thermopile is pointed at a radiating target, energy (heat) is absorbed by the blackened area inside the detector, causing a temperature differential between the sensing area and the cold junctions.
4. If the sensitivity of the thermopile is known, in terms of change of voltage output per degree of differential temperature (T.sensing junc - T.cold junc), and the temperature of the cold junction is known, then a formula can be derived to calculate target temperature.

• Equivalence

See Operation Manual: "Equivalence Explained".

If a patient's temperature were measured at four sites simultaneously – oral, rectal, arterial, and an infrared reading of the ear canal – the result would be four separate but correlated readings.

There are three reasons an infrared reading in the ear canal reads lower than core (arterial) temperature:

1. The ear is not a perfect blackbody. In a perfect blackbody, 100% of the energy from a radiating object is emitted. In the ear canal, the energy transfer is less than 100%, causing a lower reading.
2. There is some heat loss down the ear canal due to thermal gradients.

By adding linear corrections, *GENIUS* is able to compensate for the two conditions previously described. By calibrating these corrections to ambient temperature, the problem described in condition two is minimized.

2. Principles of Operation (cont.)

• Pre-Scan Buffer

When the *GENIUS* probe is inserted into the ear, the infrared detector sees a peak temperature in a matter of milliseconds. Then the peak rapidly drops off because of the heat-sinking effect of the cold probe. This effect is called "draw-down." Normally, the problem of "draw-down" would make it very difficult for someone to get an accurate infrared reading of the ear canal without missing the peak.

This problem is remedied by use of a unique "Look-Ahead" feature in the *GENIUS* software:

1. When the user installs a disposable probe cover on the *GENIUS* probe tip, if the unit is set to "TYMPANIC" mode, it will immediately start to scan for a peak temperature, before the probe is actually inserted into the ear canal.
2. It keeps approximately one second worth of temperature scans stored in a buffer. This buffer is continually refreshed.
3. When the probe is placed into the ear canal and the caps button pressed, the *GENIUS* takes another buffer of data **in addition** to the "pre-scan buffer."
4. When determining target temperature, both buffers of data are examined for the peak reading.

• Sleep Mode -vs- Wake Mode

The *GENIUS* is able to conserve battery life by automatically placing itself into a special low-power mode (**"sleep" mode**), whenever it is left unused.

1. When in "sleep" mode, the +5 volt supply is disconnected from all circuitry except the CPU.
2. Installing a probe cover will trigger an interrupt (a "reset" in newer versions), putting the CPU into its normal (**"wake"**) operating mode.
3. After "wake-up," the CPU will cause the +5 volts to become active to the rest of the circuit board. A short time after the user completes the task of taking a temperature, the CPU will again return to "sleep" mode in order to conserve power.

Sleep / Wake-Up

1. Pin 29 of the CPU is INT0. INT0 is used in this application to wake-up the CPU from low-power "sleep" mode. Note: For software revision ≥4.0, wake-up is accomplished via a warm reset, that occurs when a new probe cover is installed.
2. When the unit is residing in its base, INT0 and reset are inactive. If the unit has not been used for at least one minute, the CPU is in its low-power "sleep" mode.
3. Removing the unit from the base causes the spring-loaded release button to drop to the "down" position.
4. When a probe cover is installed, the RELEASE button is forced high, causing a high to low transition on INT0. For software revision ≥4.0, a reset occurs, rather than an interrupt, bringing the unit out of "sleep" mode.

5. If the probe cover is left in place but a temperature has still not been taken, after approximately 30 seconds, the CPU will again go into low-power "sleep" mode. If this condition occurs, the menu will display the prompt to "USE NEW COVER." To reactivate the unit, the probe cover must be RELEASED and a new cover installed.

• Power Supply

In: 9-volt alkaline battery, 540 mah
Out: ±5 volts

Current Consumption:
Sleep Mode: Approx. 25 microamps
Wake Mode: Approx. 8.5 milliamps

Battery Life:
Approximately 7 to 9 months (average 600 temps/month)

The +5 Volt Supply

1. U8, a three-terminal linear regulator is used to produce a stable +5 volt output from a 9 volt input for the digital circuits.
2. U4, a three terminal linear regulator is used to produce a stable +5 volt output from a 9 volt input for the analog circuits.
3. The +5 volt output always supplies current to the CPU.
4. When in "sleep" (low-power) mode, the CPU shuts off the +5 volts from the rest of the circuitry.
5. When the CPU is caused to "wake-up," the CPU turns on the +5 volts to the peripheral circuitry.

The -5 volt supply

The circuit uses a dc to dc converter (U9) to produce a -5 volt output from a +5 volt input.

• CPU Reset

A high-to-low transition of a specified duration is required at pin 76 of the CPU for a power-on reset.

• Liquid Crystal Display (LCD)

The drive circuitry and power to the LCD is internal to the CPU. The drive "duty-cycle" and "frequency" is a function of the 32 KHz crystal, X1.

• EEPROM

1. The *GENIUS* uses an EEPROM (Electrically Erasable Programmable Read-Only Memory) that contains special internal data protection logic to minimize the possibility of data loss.
2. The *GENIUS* calibration coefficients are contained in EEPROM memory (U2).

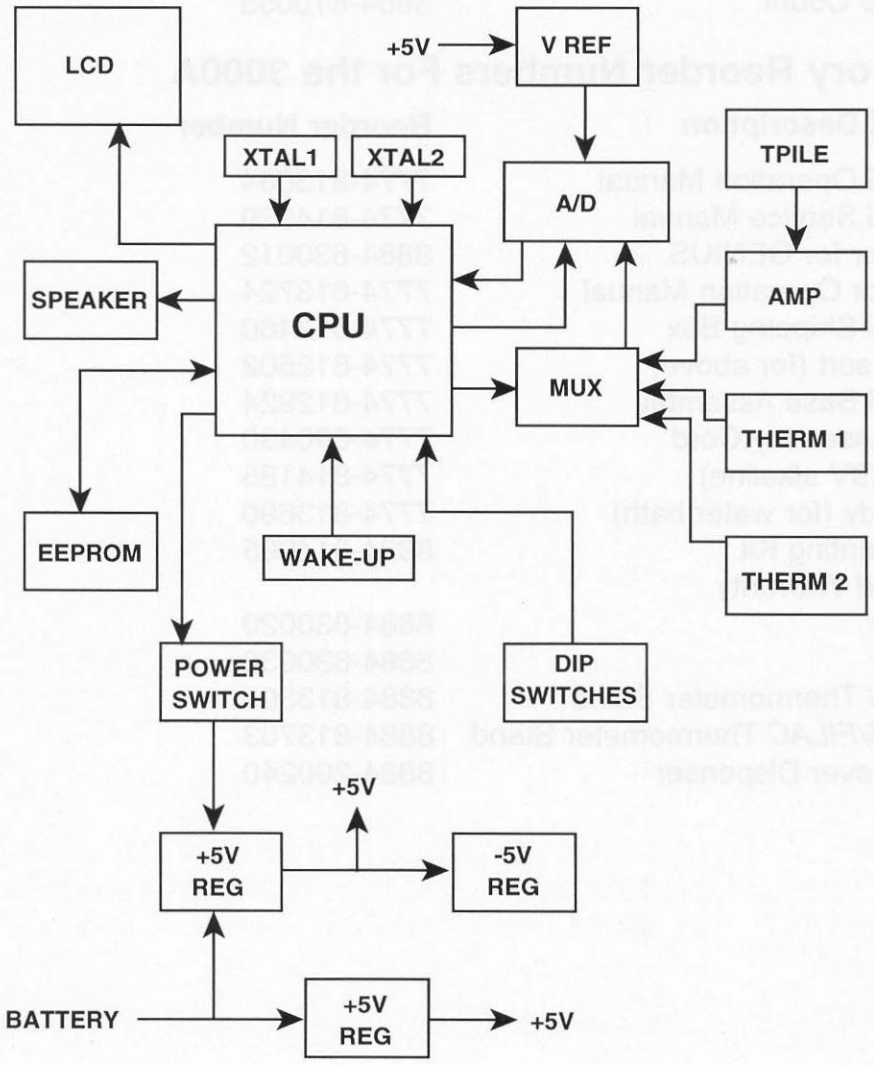
2. Principles Of Operation (cont.)

3. U2 is powered directly by one of the "high-current" I/O pins on the CPU and is normally off.
4. When the CPU desires to read or write the EEPROM, it raises the I/O, supplying current to the EEPROM, then lowers it when the task is complete.

• Analog to Digital Interface

1. U3, an "analog processor," is used to provide the analog to digital interface between the various sensors and the CPU.
2. The analog processor is being operated at a 14 bit (plus sign) resolution and performs between 30 to 50 conversions per second (depending on amplitude of the input).

GENIUS Block Diagram – Figure A



3. Product Description

General Description

The *GENIUS* Infrared Tympanic Thermometer is designed to noninvasively measure clinical temperature intermittently in 1 to 2 seconds. Results may be converted to the Fahrenheit or Celsius scale and adjusted to a "ORAL," "RECTAL" or "CORE" equivalent.

GENIUS is a microprocessor-controlled, battery-operated, hand-held instrument. A base unit, which holds 21 probe covers at a time, is packaged with the *GENIUS* and may be optionally wall-mounted. There are no electrical components in the base unit.

• Product Reorder Numbers

Product Description	Reorder Number
GENIUS Model 3000A	8884-830004
Probe Covers	
2,100 Count	8884-810055

• Accessory Reorder Numbers For the 3000A

Product Description	Reorder Number
GENIUS Operation Manual	7774-813864
GENIUS Service Manual	7774-814029
Calibrator for GENIUS	8884-830012
Calibrator Operation Manual	7774-813724
GENIUS Shipping Box	7774-812460
Foam Insert (for above)	7774-812502
GENIUS Base Assembly	7774-812924
Coiled Assembly Cord	7774-090430
Battery (9V alkaline)	7774-814185
Blackbody (for water bath)	7774-813690
Wall Mounting Kit	8884-814065
·Extended Warranty	
1 Year	8884-830020
2 Year	8884-830038
GENIUS Thermometer Stand	8884-813301
GENIUS/FILAC Thermometer Stand	8884-813703
Probe Cover Dispenser	8884-200240

3. Product Description (cont.)

Physical Description

The *GENIUS* Thermometer is housed in a white/blue, ABS plastic, impact-resistant case measuring 8.5" long x 2.2" wide x 3.0" high. Frequently used controls include the SCAN momentary pushbutton located on the top, and the MODE momentary pushbutton located on the bottom left side of the probe. Less frequently used switches are located inside a panel located on the underside of the probe.

The base unit is housed in a white, ABS plastic, impact-resistant case measuring 9.2" long x 2.7" wide x 2.0" high. The base may be optionally tethered to the probe via a coiled security cord. There are no electrical connections to the probe. Disposable probe cover cassettes may be stored in the base, which may be wall mounted. A positive spring latch is provided to secure the probe while carrying the thermometer. A clear, plastic door (optionally removable) protects the probe covers from debris.

• Indicators

A single, custom, liquid crystal display (LCD) provides multiple types of information:

1. Normal temperature display in tenths of a degree.
2. Temperature display used during calibration in hundredths of a degree.
3. Diagnostic information intended for the user and biomedical engineer.
4. In-service menu system which provides user prompting.
5. Error indicators.
6. Battery condition.
7. Equivalence settings.
8. Temperature acquisition mode: TYMPANIC or TIMER.

• Controls

GENIUS has the Following External Controls:

SCAN button

A. Press and release to obtain tympanic temperature when in "TYMPANIC" mode.

B. Press and release to begin 15 second pulse timer when in "TIMER" mode.

C. Numerous special functions when used in conjunction with internal DIP switches. (See page 21, "Special Functions.")

MODE button

A. Press to sequence through TYMPANIC → TIMER modes. This function is enabled only when the LOCK DIP switch is in the unlocked position. For clinical use, the device should remain locked on "TYMPANIC." The timer option is still available regardless of lock.

B. Press and HOLD to sequence between °F and °C. The mode button should be depressed for approximately six seconds. The currently displayed temperature will be converted, as well as all subsequent temperatures. In the event of a battery replacement, the unit will default to the DIP switch #5 setting.

GENIUS has the Following Internal DIP Switch Controls:

CALIB

(Calibrate): When in CALIB position, each press of the SCAN button increases the calibration offset of *GENIUS* by 0.05°F; Each press of the MODE button decreases the calibration offset by 0.05°F. The LCD shows the current setting which will be stored in EEPROM when the CAL switch is returned to NORM. When in NORM position, the calibration is locked.

SPC

(Special Functions): When in SPC position, a variety of diagnostic functions are displayed. (See page 21, "Special Functions" for specific descriptions.)

EQUIV

When in the EQUIV position, pressing MODE will sequence the equivalence setting from CAL → ORAL → RECTAL → CORE. When in the NORM position, equivalence is locked to the setting shown on the LCD.

LOCK

When in unlocked position, the MODE button allows changing the temperature mode. When in LOCK position, the MODE button may be used to change temperature scale only or to select the TIMER function. Unit should remain locked in "TYMPANIC" mode for clinical uses.

DEGREES F / DEGREES C

The position of this switch determines the default temperature scale displayed when a power-up reset occurs (i.e. during battery change).

3. Product Description (cont.)

Functional Description

• Tympanic Mode

"TYMPANIC" mode is the clinical mode of operation. It should always be selected when taking an ear temperature.

When taking a temperature in "TYMPANIC" mode, the *GENIUS* looks for and holds the **peak** temperature reading. This will be the temperature displayed on the LCD. See the Operation Manual for detailed instructions and techniques involving taking tympanic temperatures.

NOTE: A probe cover must be in place or the *GENIUS* will not respond to the SCAN button. (See page 16, "In-Service Menu System.")

• Timer Mode

When "TIMER" mode is selected, the *GENIUS* becomes a 15-second timer. This feature was designed to give the nurse a convenient stopwatch for use in taking a patient's pulse. See Operation Manual for use of "TIMER" mode.

Specifications

• General Description

The *GENIUS* Infrared Tympanic Thermometer is designed to non-invasively measure clinical temperature intermittently in 1 to 2 seconds. The ear canal is used as the temperature determination site. Results may be switched between the Fahrenheit or Celsius scale and adjusted to a "ORAL," "RECTAL" or "CORE" equivalent.

GENIUS is a microprocessor-controlled, battery-operated, hand-held instrument. A base unit, which holds a cassette of 21 probe covers at a time, is packaged with the *GENIUS* and may be optionally wall mounted. There are no electrical components in the base unit. A new probe cover is required for each use. In order to ensure accurate temperature measurements, use ONLY probe covers manufactured by Sherwood-Davis & Geck.

The *GENIUS* Model 3000A has been designed to comply with the ASTM Standard for Intermittent Electronic Clinical Thermometers, E1112-86.

• Accuracy

GENIUS displays temperatures in 0.1 or 0.01 °F or °C resolution. For most clinical uses, 0.1° scale should be used. The accuracy, as determined using a 3000A-BB blackbody in a stirred water bath and a NIST traceable reference thermistor (accurate to .01°C) is as follows:

The calibrated accuracy limits are based on ASTM standard E1112-86. In the range 36.7 to 38.9°C (98 to 102°F) the tolerance is ±0.1°C (±0.2°F).

• Specification Limits

RANGE	Accuracy °F	Accuracy °C
Less than 96.8°F (36°C)	±0.5°F	±0.3°C
96.8°F (36°C) to 102.2°F (39°C)	±0.4°F	±0.2°C
Greater than 102.2°F (39°C)	±0.5°F	±0.3°C

3. Product Description (cont.)

• Mechanical

Size: Probe – 8.5" L x 2.2" W x 3.0" H

Base – 9.2" L x 2.7" W x 2.0" H

Weight: Probe – 7 ounces

Base – 11 ounces

• Environmental

Operating Temperature:	60°F to 95°F (15.6°C to 35°C)
Storage Temperature:	-4°F to 122°F (-20°C to 50°C)
Humidity Range:	10% to 95% non-condensing

• Electrical

GENIUS requires one 9-volt battery. An alkaline battery is supplied with the unit, which provides approximately 5000 temperatures. This provides a life of about nine months with typical use. The unit powers up when the battery is inserted. There is no ON/OFF switch. After a period of inactivity, the unit enters a sleep mode to extend battery life.

Current consumption:

Taking a temperature:	approx. 8.5 milliamps
Idle:	approx. 25 microamps

4. Installation and Operation

Initial Setup

• Unpacking

You should have received the following material within your individual *GENIUS* shipper box:

1. FirstTemp *GENIUS* Model 3000A Tympanic Thermometer and base unit. (Coiled cord assembly is included.)
2. Battery: 9-volt alkaline. (May be installed.)
3. Operation Manual.
4. Cassette of 21 disposable probe covers already installed in the *GENIUS* base unit.

• Battery Installation

You may receive your *GENIUS* with the battery pre-installed. However, should it be necessary to install the battery, proceed as follows:

1. Unscrew the two Phillips-head screws to the battery compartment. The battery compartment is located near the "security cord" end of the unit.
2. Insert a 9-volt alkaline battery into the compartment. Insert the battery with the contacts facing outward.
3. Install the battery snap to the battery contacts. The unit will perform a series of self-diagnostic tests (described on page 13, "Power-On Self Diagnostics").
4. The initial temperature scale is determined by DIP switch #5 which is described on page 14, "Factory Defaults." If a different setting is desired, install a probe cover and hold down the MODE button until the temperature scale changes. This takes approximately six seconds.

4. Installation and Operation (cont.)

Power On and System Check

• Power-On Self Diagnostics

During battery installation, *GENIUS* will undergo a series of self diagnostics. They are as follows:

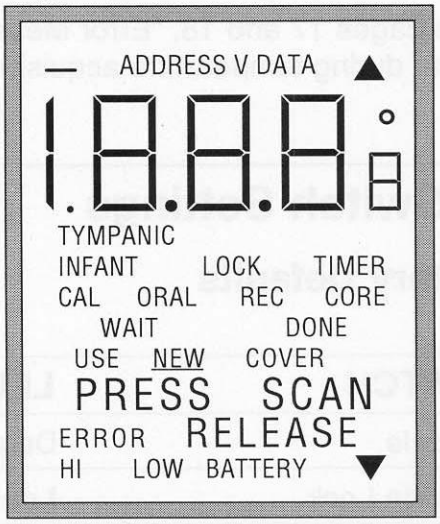
1. SPEAKER TEST

   You will hear the speaker beep once. Verify that the speaker functions.

2. LCD DISPLAY

   For approximately 3 seconds, the unit will activate all LCD indicators. Compare this display to that shown right. (Figure B)

Figure B



3. ROM RELEASE NUMBER

   After the LCD test, the unit will briefly display its software release number. After about 1 second, this number will blank.

4. TEST EEPROM (Calibration Table)

   The unit will perform a checksum on the calibration data stored in EEPROM. If this checksum fails, the unit will display an error indicator with the number "1."

5. FINAL DISPLAY

   After performing tests 1 through 4, the *GENIUS* LCD will default to "TYMPANIC" mode (see page 9, "Tympanic Mode") and either °F or °C (see pages 14, "DIP Switch Settings," and 15, "Switch Functions"). The "In-Service Menu System" (see page 16, "In-Service Menu System," or "Special Features" in the Operation Manual) will either say "USE NEW COVER" (if no probe cover in place) or "PRESS SCAN" (if a probe cover is in place).

Your *GENIUS* is now ready for use.

Even though SURFACE MODE is not used, the indicator is on the LCD and will light.

• Continuous Self Diagnostics

During use, the device performs the following self test approximately once each second:

1. TEST EEPROM

   (See page 13, "TEST EEPROM.")

2. BATTERY CHECK

   First stage low battery warning occurs when the battery voltage is approximately 6 volts. The words "Low Battery" will appear on the LCD. The second stage warning occurs when the battery voltage has reached approximately 5.6 volts. The word "Error" along with "Low Battery" appears on the LCD and the device will become disabled until a new battery is installed.

3. ERROR MESSAGES

   See pages 17 and 18, "Error Messages" for a description of error messages that can occur during temperature acquisition.

DIP Switch Settings

• Factory Defaults

SWITCH	LEFT	RIGHT
5 Scale	Degrees Celsius	**Degrees Fahrenheit**
4 Mode Lock	**Locked**	Unlocked
3 Equivalence	Set Equivalence	**Locked**
2 Special Function	Special	**Normal**
1 Calibrate	Calibrate Mode	**Normal**

Note: Factory defaults appear in **Bold** lettering.

• Changing DIP Switch Settings

When changing any DIP switch setting after the unit has already powered up, except for switch 5, which requires that the battery be disconnected and reconnected, always perform the following:

1. Bring the unit out of sleep mode (see page 2, "Theory of Operation") by installing a probe cover on the 3000A probe tip. Leave it there for the remainder of this procedure.
2. Move the appropriate DIP switch to perform the desired function.
3. Release the disposable probe cover.

4. Installation and Operation (cont.)

• Switch Functions

1. SWITCH 5: °F/°C

   The position of this switch determines the "power-on reset" default for configuration in either °F or °C. For example: If switch 5 is moved to the left position, the LCD would initialize with °C display at the time of battery installation.

   After the initial "power-on reset," changing the switch position has no effect on the unit.

2. SWITCH 4: LOCK/UNLOCK TYMPANIC

   Note: A description of the temperature mode: "TYMPANIC" can be found in Sections 1 and 2 of the Operation Manual.

   When this switch is moved to the left, the unit will remain locked in its previously selected mode ("TYMPANIC"). This switch does not lock out the 15-second timer function or Fahrenheit/Celsius conversion. Factory default is locked in "TYMPANIC" mode.

3. SWITCH 3: EQUIVALENCE SET/LOCK

   When moved to the left, allows user to change "equivalence setting." Move back to the right to lock equivalence into place. (See Operation Manual, "SPECIAL OPERATING CONTROLS" for a description of "Equivalence.") Unit will not take a temperature until the switch is returned to the right position.

4. SWITCH 2: SPECIAL FUNCTIONS

   This function enables a special diagnostic program for use by factory technicians only. It aides the technician in isolating hardware problems by giving a digital readout for each of the sensing components in the *GENIUS*. This switch should be left in the "right hand" position for normal use. Unit will not take a temperature until the switch is returned to the right position.

   Covered in more detail on page 21, "Special Functions."

5. SWITCH 1: CALIBRATE

   For use with Sherwood-Davis & Geck *GENIUS* Electronic Calibrator, Model 3000A-CL.

   After checking *GENIUS* calibration in the electronic calibrator, it may be deemed necessary to provide a small linear adjustment to the calibration. Unit will not take a temperature until the switch is returned to the right position.

• Adjusting Calibration Offset

To adjust calibration, move switch 1 to the left position. The current calibration offset will be displayed on the *GENIUS* LCD to the nearest .05°F. To increase the calibration (cause *GENIUS* to read higher), press the SCAN button. Each press of the SCAN button will increase the calibration by .05°F. To decrease the calibration (cause *GENIUS* to read lower), press the MODE button. Each press of the MODE button decreases the reading by .05°F. After adjusting calibration, return the switch to the right hand position.

Note 1: Calibration offset is always displayed in °F. Exiting the "offset adjust" routine will result in forcing the unit into °F display. If °C is desired, simply place a probe cover on the tip and hold in the MODE button for approximately 6 seconds.

Note 2: Beginning with 3000A software release 3.10, a calibration offset in excess of ±0.95°F will result in an "error 5" displayed upon exiting the function. To correct the error, reduce the calibration offset to a value below this limit. Note: If the unit requires a calibration offset approaching the .5°F limit, it may be indicative of a problem with the 3000A Thermometer. It would be advisable to call Sherwood-Davis & Geck Customer Service.

Note 3: See page 20, "User Calibration," before ever attempting to adjust factory calibration.

• Changing °F/°C with the Mode Button

The °F/°C display toggles by holding in the MODE button on the *GENIUS* for more than six seconds.

Indicators and Error Messages

(See page 13, Figure B for complete LCD.)

• In-Service Menu System

(Also see Service Manual, "Special Features.")

1. "USE NEW COVER" is displayed when the *GENIUS* is in normal operating mode and waiting for a disposable probe cover. The unit is designed to **not allow** a temperature to be taken until a probe cover is in place.
2. "PRESS SCAN" is displayed when a probe cover has been placed on the *GENIUS* probe tip and the unit is ready to take a temperature.

Special NOTE for Software < 3.10:

The user is allowed 45 seconds in which to press SCAN after installation of a probe cover. If this time is exceeded, *GENIUS* will display "USE NEW COVER." This is due to the low power "Sleep" mode feature. To reactivate the unit, eject the probe cover by pressing the RELEASE button and install another probe cover.

Software ≥ 3.10:

The 45-second time-out period has been changed to 30 seconds. However, the clock does not start counting until **after** the probe cover has been installed.

3. "PRESS RELEASE" is displayed upon completion of a tympanic temperature. The *GENIUS* expects the user to press the RELEASE button and release the disposable probe cover.
4. "DONE" will flash for a few seconds upon completion of a tympanic temperature.
5. "WAIT" will be displayed soon after the last temperature has been completed. "PRESS SCAN" will be displayed at the conclusion of the wait period.

4. Installation and Operation (cont.)

• Mode Indicators (Tympanic, Timer)

For a detailed description of "TYMPANIC" and "TIMER" modes of operation, see page 9, "Functional Description" or "Operating Controls" in the Operation Manual.

The "MODE" button is used to switch between the two modes of operation.

1. "TYMPANIC" shows on the LCD when the unit is configured to take "tympanic" (ear) temperatures. This is the most common mode of operation.
2. "TIMER" shows on the LCD when the unit is configured in the "15-second timer" mode.

• Equivalence Indicators

For a detailed description of "Equivalence," see "Equivalence Explained" in the Operation Manual as well as on page 2, "Theory of Operation," in this manual.

1. "CAL" shows on the LCD when no equivalence offset is enabled. This should be the configuration when checking *GENIUS* calibration in the 3000A-CL Electronic Calibrator or the 3000A-BB Waterbath Target (see page 20, "User Calibration").
2. "ORAL" shows on the LCD when the "Oral" equivalent mode is selected.
3. "RECTAL" shows on the LCD when the "Rectal" equivalent mode is selected.
4. "CORE" shows on the LCD when the "Core" equivalent mode is selected.

• Error Messages

"LOW BATTERY"

When the 9-volt alkaline battery has discharged to approximately 6 volts, the LCD will display "LOW BATTERY" at the bottom of the display. The unit will still function at this point. However, it is recommended that a fresh battery be installed as soon as possible.

"LOW BATTERY" with "ERROR"

If "LOW BATTERY" and "ERROR" are showing simultaneously, the unit is into the 2nd stage of its low battery warning. This occurs when the battery is at approximately 5.6 volts. The unit will not function at this point until a new battery is installed.

"ERROR HI"

This error occurs when the target temperature is in excess of 110°F (43.3°C). (See page 10, "Specifications" for description of specifications.) If this error ever occurs, it will automatically be cleared the next time a temperature is taken which is within the specified target range.

"ERROR LOW"

This error occurs when the target temperature is less than 60°F (15.6°C). (See page 10, "Specifications" for description of specifications.) If this error occurs, it will automatically be cleared the next time a temperature is taken which is within the specified target range.

"ERROR" with an "UP" arrow

This error message will appear if the ambient environment is in excess of 100°F (38°C).

"ERROR" with a "DOWN" arrow

This error message will appear if the ambient environment is less than 60°F (15.6°C).

"ERROR" with a single number in the display.

ERROR 1: EEPROM CHECKSUM error. Calibration memory corrupted. Unit must be returned to Sherwood-Davis & Geck for repair and re-calibration.

ERROR 2: Serial interface communication error. The serial interface is not used in the field. This error is unlikely to occur, but if it does, please return the unit to Sherwood-Davis & Geck for repair and re-calibration.

ERROR 3: Unable to clear the EEPROM protect address. This signifies a defective EEPROM. Unit must be returned to Sherwood-Davis & Geck for repair and re-calibration.

ERROR 4: Unable to write to the EEPROM. This signifies either a defective EEPROM or a communications breakdown between the CPU and the EEPROM.

ERROR 5: (For software ≥ 3.10 only.) Occurs whenever the 1-point offset has been adjusted to an absolute value of greater than ±0.95°F. Contact your Sherwood-Davis & Geck customer service representative for assistance.

5. Maintenance

Introduction

The *GENIUS* is constructed using solid-state electronics, with surface-mount components for durability and reliability. The only moving part in the probe is the RELEASE button assembly which provides for long service life. There are no electronic adjustments available to the Biomedical Engineer. All calibration is performed digitally and is stored in non-volatile EEPROM.

Warranty Policy

GENIUS is covered by a three-year parts and labor warranty. Should your *GENIUS* require service, contact Sherwood-Davis & Geck to arrange for return authorization as described below. For plan 1, the replacement *GENIUS* will carry a warranty period equal to the balance of the unused warranty period of the original unit or 90 days, whichever is greater. For the warranty to be valid, the security label covering one of the screws on the underside of the probe must be present and undamaged.

• Plan 1: Advance Replacement

Notify Sherwood-Davis & Geck and return your *GENIUS*. A refurbished replacement will be shipped to you via UPS second day air. This replacement will carry a different serial number than your original unit.

• Plan 2: Warranty Repair

Call Customer Service at (800) 448-0190 for a return authorization number and shipping instructions. Your original unit (same serial number) will be repaired and returned to you.

Recommended Calibration Interval

The *GENIUS* is constructed with components selected for their extremely low, long-term drift characteristics. Furthermore, two burn-in cycles during manufacture minimize calibration drift. However, all electronic components exhibit some degree of drift over time. To ensure accuracy to specification, Sherwood-Davis & Geck recommends calibration checks at intervals not to exceed 6 months. Harsh use or environmental changes may require calibration intervals to be reduced at some facilities. If the unit is dropped or abused in any way, calibration prior to next use should be checked.

User Calibration

Factory Calibration -vs- User Calibration:

The user is given the ability to check the 3000A calibration in the field by using any one of the three listed acceptable calibration sources. The primary calibration source is the FirstTemp Genius Calibrator Model 3000-PC which is designed to check the calibration of the Genius thermometer and, if necessary, recalibrate the thermometer. The secondary calibration sources are the FirstTemp Genius Electronic Calibrator Model 3000A-CL and the Sherwood-Davis & Geck designed blackbody used with a Sherwood-Davis & Geck approved electronically controlled waterbath and N.I.S.T. traceable temperature sensor. The secondary calibration sources are used to check the calibration of the thermometer and, if necessary, allow the user to adjust the calibration by applying an offset to the thermometer. If the Genius 3000A calibration cannot be corrected to specification by using either one of the three calibration sources, the thermometer will have to be returned to the factory to undergo repair and an extensive calibration process. In most cases, however, these calibration sources will be able to recalibrate and adjust the thermometer to bring the calibration back into specification (See page 10, "Specifications").

• Calibration Sources

Since the Genius 3000A is a noncontact radiation thermometer, it must be stressed that all conventional methods used to check the calibration on a "contact" thermometer do not apply and, in fact, could seriously damage this thermometer. The importance of using a proper "blackbody" radiator as the ONLY type of calibration source cannot be overemphasized. Furthermore, because of the unique shape of the Genius probe head, it is not possible to rely on commercial infrared calibration devices provided for other infrared thermometers. These commercial devices do not guarantee proper probe head alignment with the calibration target cavity.

Acceptable Calibration Sources:

Primary:

1. Sherwood-Davis & Geck FirstTemp Genius Calibrator Model 3000-PC

Secondary:

1. Sherwood-Davis & Geck FirstTemp Genius Electronic Calibrator Model 3000A-CL
2. Sherwood-Davis & Geck designed "blackbody" used with a Sherwood-Davis & Geck approved electronically controlled waterbath and N.I.S.T. traceable temperature sensor accurate to within .01°C.

Unacceptable Calibration Sources:

1. Sherwood-Davis & Geck FirstTemp Electronic Calibrator Model 2000A-CL. The shape of the calibration cavity is such that the Genius will not fit properly into the device.
2. The human ear is not to be used as a calibration device because of "emissivity" and "draw-down" effects (See page 2, "Equivalence" and page 3, "Pre-Scan Buffer" for explanations of "emissivity" and "draw-down," respectively).

5. Maintenance (cont.)

• Using the 3000-PC Calibrator

Since a complete Operation Manual is shipped with every 3000-PC calibrator, the procedure for using the 3000-PC is not repeated here. Before attempting to use the 3000-PC calibrator and **especially** before attempting to recalibrate a Genius 3000A thermometer, read the Operation Manual carefully and thoroughly.

• Using the 3000A-CL Electronic Calibrator

Since a complete Operation Manual is shipped with every 3000A-CL electronic calibrator, the procedure for using the 3000A-CL is not repeated here. Before attempting to use the 3000A-CL calibrator and **especially** before attempting to recalibrate a Genius 3000A thermometer, read the Operation Manual carefully and thoroughly.

• Using a Blackbody in an Electronically Controlled Waterbath

Since the instructions for using the Sherwood-Davis & Geck blackbody are shipped with each unit, the procedure is not repeated here. Be sure to read the instructions thoroughly before attempting to use the device. Technical assistance is available from the factory by calling (800) 448-0190.

Special Functions

The *GENIUS* software provides several special diagnostic functions which can be accessed via DIP switch "2." (See page 14, "DIP Switch Settings.") With the exception of "one-hundredth degree resolution mode," these functions are intended for Sherwood-Davis & Geck factory technicians only. Unless the technician is intimately familiar with the system hardware, the "analog to digital" diagnostic readouts will not be of much value. There may be occasion, however, where a Sherwood-Davis & Geck customer service technician may want to walk a technician through these functions over the telephone, in order to help diagnose a problem.

There are five special functions in all:

1. "Thermopile" analog to digital readout.
2. "Ambient monitoring" analog to digital readout.
3. "Probe tip thermistor" analog to digital readout.
4. "Pre-amplifier offset output" analog to digital readout.
5. "One-hundredth degree resolution" mode.

• Accessing Special Functions

1. Slide DIP switch "2" to the left position.
2. Install a disposable probe cover.
3. The LCD will display "SPC" and a triple beep will be heard.
4. To exit "Special Functions," return the DIP switch to the right. This can be done from within any of the "Special Functions" routines.

Thermopile A/D Readout:

From "SPC," hit the MODE button once. You will hear a beep and see a hexadecimal readout on the LCD. You can verify that the thermopile is at least functioning by moving your hand back and forth in front of the probe tip. You will see the readout increase as your hand moves in front of the tip and decrease as your hand moves away. This indicates nothing about the actual performance of the thermopile. It simply tells you whether or not the thermopile, with its associated circuitry, is functional.

Reference Thermistor:

From "thermopile A/D readout," hit the MODE button again. The speaker will beep and the displayed hexadecimal readout will change. This is the analog to digital conversion from the voltage divider between the "reference (head) thermistor" (TH1) and a resistor. As the probe head heats up, the reading will decrease (and vice versa).

Probe Tip Thermistor:

From "reference thermistor A/D readout," press the MODE button again. The *GENIUS* will beep and display a new hexadecimal readout on the LCD. This is the analog to digital conversion of the voltage divider between the "probe tip thermistor" (TH2) and a resistor. As the temperature of the probe tip increases, the A/D count will decrease. As the temperature of the probe tip decreases, the A/D count will increase.

Pre-Amp Offset Output:

U6 is the pre-amplifier for the thermopile detector. All amplifiers will experience some offset drift over long periods of time. In the *GENIUS,* the offset is periodically checked and is factored into the calibration equation when calculating target temperature. From "probe tip thermistor A/D readout," press the MODE button once more. The display will now show a hexadecimal reading of the inherent offset of the amplifier. A reading of 4000 is equivalent to zero volts. Typically, the unit will display a reading in the range of 3E00 to 4200. If the reading is less than 3E00 or higher than 4200, return the unit to Sherwood-Davis & Geck Customer Service.

One-Hundredth Degree Resolution:

The .01°F resolution is used when checking system calibration. By taking several repeated temperatures in the calibration target and then averaging, the effects of "repeatability error" can be minimized when determining whether or not to adjust calibration. Taking patient temperatures in the .01°F resolution is not recommended due to the fact that it is clinically insignificant.

To Activate .01°F Mode:

1. Enter "SPC" as described on page 21, "Accessing Special Functions."
2. Hit the SCAN button once. You will hear a triple beep and the LCD will briefly display "100."
3. Exit "SPC" by returning DIP switch "2" to the right.
4. The *GENIUS* will now display temperatures to the nearest one-hundredth degree resolution.
5. To return to "one tenth" degree resolution:
   a. Enter "SPC."
   b. Exit "SPC."

Note: In earlier software revisions, you may lose the displayed °F or °C symbol upon exiting "SPC." To restore, use the MODE button to toggle between °F and °C. The symbol will return and remain on the display.

5. Maintenance (cont.)

Cleaning / Sanitizing

(See attached cleaning procedure.)

To avoid damage, **never** autoclave or submerge *GENIUS* in sterilant or other solutions.

• White and Blue Plastic Parts (Thermometer Probe and Base)

Clean with a cloth dampened with warm water and a mild detergent or with a less than 10% bleach solution or with isopropyl alcohol. See table on the following page for use of other acceptable cleaning agents.

CAUTION: See special instructions below for cleaning probe lens.

• Clear Plastic Windows

Wipe display window and disposable door window using a cloth dampened with mild detergent. **Do not use alcohol.** See table on the following page for other acceptable agents.

• Probe Lens (Black Window in Probe Tip)

Gently clean using a lens wipe or lint-free swab. Lens should appear shiny and free of fingerprints and debris. If soil remains or the use of isopropyl alcohol is necessary:

1. Slightly dampen a cotton-tipped swab with isopropyl alcohol. Blot the excess cleaning agent off the swab, using a clean lens tissue.
2. Point the probe tip down and gently clean the lens with a dampened swab. Do not apply excessive force which could squeeze out alcohol from the swab.
3. Follow with a lint-free wipe to remove the alcohol film.
4. Allow 45 minutes drying time prior to using the thermometer.

Cleaning Agent (Examples)	**Probe Lens**	**Clear Plastic Windows**	**White/Blue Plastic Parts**
Isopropyl Alcohol (Any Supplier)	✓*	**DO NOT USE**	✓
Mild Detergent (Soap in water; Liquid dish-washing soap and water)	**DO NOT USE**	✓	✓
Bleach (<10%)(Clorox®)	**DO NOT USE**	✓	✓
Glutaraldehyde (Cidex®)	**DO NOT USE**	✓	✓
Phenolics (Lysol® Disinfectant, Wexcide®)	**DO NOT USE**		✓
Acetone (Any supplier)	**DO NOT USE**		
Quaternary Ammonium (Lysol® Deodorizing Cleaner, Microquat®)	**DO NOT USE**		
Butyl Cellosolve® (Spray 9®, Formula 409®)	**DO NOT USE**		

✓ = Acceptable Cleaning Agent

***CAUTION: Use alcohol only when soil damage cannot be removed with a dry lens wipe. Excessive use of alcohol may result in inaccuracy or damage.**

6. Specifications

For Genius Model 3000A Tympanic Thermometer

Calibrated Accuracy: ±0.2°F (±0.1°C) 98°F-102°F. Based on ASTM standard E1112-86.

Calibrated Temperature Range: 85°F-110°F (29.4°C-43.3°C).

Ambient Temperature Operating Range: 60°F-95°F (15.6°C-35°C).

Storage Temperature Range: -4°F to 122°F (-20°C to 50°C).

Response Time: Approximately 1-2 seconds.

Primary Modes: Tympanic and Timer.

Resolution: 0.1°F or 0.1°C displayed on LCD.

Power: One 9-volt alkaline battery.

Battery Life: Approximately 5,000 temperatures.

Two-Stage Battery Warning: At Stage 1, replace battery as soon as practical. At Stage 2, replace battery immediately or thermometer will not operate.

Temperature Conversion: User-programmable for rectal, oral or core equivalences (°F or °C).

Unique Features: Incorporates 15-second pulse timer. Instant In-Service Menu System prompts on method of use via LCD screen. Calibration may be checked at user site with Genius calibrator.

Size: Probe = 8.5"L x 2.2"W x 3"H
Base = 9.2"L x 2.7"W x 2"H

Weight: Probe = 7 oz.
Base = 11 oz.

Disposables: Base holds 21-probe cover cassette.

Base: May be wall-mounted or cart-mounted.

This equipment complies with the requirements in Part 15 of the FCC rules for Class A computing devices. Made and/or sold under one or more of the following United States Patents: 4,602,642; 4,662,360; 4,790,324; 5,024,533; 5,179,936; 5,232,284; 5,293,862; 5,293,877; DES 303,008 Foreign Patents issued. Other U.S. and Foreign Patents Pending.

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7. Factory Service Information

There are no user serviceable parts inside the Genius unit. Opening the device may affect calibration of the unit. For warranty service or technical assistance, please contact your Sherwood-Davis & Geck Representative, at (800) 448-0190 or (315) 788-5246 for instructions. If a unit requires factory service, carefully pack the thermometer unit and ship via parcel post to:

Sherwood-Davis & Geck
98.6 Faichney Drive
Watertown, NY 13601